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Differentiating Benign and Malignant Musculoskeletal Soft Tissue Tumours on Ultrasound; Grayscale and Duplex Sonography

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ABSTRACT
BACKGROUND: *Ultrasonography is usually performed as a first step in the assessment of musculoskeletal soft tissue masses. Its ready applicability and availability, high affinity at discriminating tissue layers, good spatial and contrast resolution, real-time imaging capability has made it a useful tool in assessing soft tissue masses.Comparative angiographic and pathologic studies have demonstrated that newly formed tumor vessels show distinct features which can readily be detected by use of color Doppler and Spectral Wave Analysis and help to differentiate benign from malignant tumors.*
MATERIALS AND METHODS: *Study design: Prospective study was conducted on 56 Patients in Dept. of Radiodiagnosis ,Mamatha General Hospital, Khammam.Study period: The study was conducted for a duration of 1 year between May, 2021 to May, 2022.Each lesion was examined on Gray scale, colour doppler ultrasonography with spectral wave analysis on Mindray.For spectral analysis, low values of PRF were used; when necessary, the PRF was adjusted for medium to high blood flow velocities.*
RESULTS:*B-mode ultrasonography in differentiating benign from malignant musculoskeletal soft tissue masses.*
Sensitivity : 47.5% PPV: 78.2%
Specificity: 80.3% NPV: 62.8%
Colour doppler and spectral wave analysis in differentiating benign from malignant musculoskeletal soft tissue masses.
Sensitivity: 76.4% PPV: 76.1%
Specificity: 76.4% NPV: 83.7%
Accuracy of B-mode ultrasound = 62%
Accuracy of colour wave and spectral ultrasound= 76%
CONCLUSION: *By our study we concluded that we can use B-mode, color Doppler ultrasonography and spectral wave analysis for assessing musculoskeletal soft tissue masses with good accuracy, sensitivity, specificity, positive predictive value and negative predictive value.*
We can reliably differentiate benign from malignant soft tissue masses by using morphological as well as color Doppler features. Low Resistive indices (= or less than 0.5) of the internal vessels within the tumors also showed significant correlation with the malignant nature of the lesion. Thus spectral wave analysis can reliably differentiate benign from malignant soft tissue masses on the basis of resistive indices.
KEYWORDS: *SOFT TISSUE TUMORS, BENIGN, MALIGNANT, USG, COLOUR DOPPLER*

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I. INTRODUCTION:

Musculoskeletal soft tissue can be defined as the periskeletal non-epithelial connective tissue of the body exclusive of reticuloendothelial system. It is represented by the voluntary muscles, fat and fibrous tissue along with the vessels serving these tissues. By convention, it also includes the peripheral nervous system because tumors arising from nerves present as soft tissue masses and pose similar problems in differential diagnosis and therapy[1]Ultrasonography is usually performed as a first step in the assessment of musculoskeletal soft tissue masses. Recent advances in ultrasound technology have enabled the echotexture of soft tissue tumors to be presented in greater detail.[2]It enables the differentiation of benign and malignant masses and the detection of many different types of histology in musculoskeletal soft tissue masses. It is cheap, fast and delivers low radiation. It helps to evaluate the presence of calcification within the lesion and its effect on the adjacent bones and possible fracture risk[3]

Comparative angiographic and pathologic studies have demonstrated that newly formed tumor vessels show distinct features (abnormal vessel arrangement, abrupt variation in calibre of vessels, tortuosity, arteriovenous shunting); such features and the resulting blood flow abnormalities can readily be detected by use of color Doppler and Spectral Wave Analysis also the extension through different anatomic compartments and guiding biopsy. However, it remains operator dependent and irreproducible [4]

II. AIMS AND OBJECTIVES:

The purpose of this study is to evaluate the role of greyscale ultrasound and duplex sonography in differentiating benign from malignant musculoskeletal soft tissue masses, in order to assess whether these methods are able to increase the diagnostic accuracy of B-mode ultrasonography.

III. MATERIALS AND METHODS:

The Prospective study was conducted on 56 Patients in Dept. of Radiodiagnosis ,Mamatha general hospital, Khammam.
The study was conducted for a duration of 1 year between May, 2021 to May, 2022
Each lesion was examined on Gray scale, colour doppler ultrasonography with spectral wave analysis on Mindray.
For spectral analysis, low values of PRF were used; when necessary, the PRF was adjusted for medium to high blood flow velocities.
Sonographic features evaluated were growth pattern, margins, echogenicity, and internal texture.
Growth pattern was defined as expansive (rounded or ovoid lesion compressing adjacent structures), infiltrating (poorly detectable lesion distorting normal structures), or mixed (association of both aspects).
Margins were defined as regular (smooth), irregular (shaggy), or blurred (poorly defined).
Echogenicity was defined as hypoechoic, hyperechoic, or isoechoic relative to adjacent muscle tissue.
Internal texture was defined as homogeneous, heterogeneous, or complex (mixed, with fluid components).
Definitive diagnosis was provided by histologic study for all patients.

IV. RESULTS:

AMONG BENIGN LESIONS	
AVM	12
BENIGN SPINDLE CELL TUMOR	8
INTRAMUSCULAR LIPOMA	2
GCT TENDON	1
NEUROFIBROMA	1
DESMOID	1
SCHWANNOMA	1
BENIGN FIBROHISTIOCYTIC TUMOR	1
CAROTID BODY TUMOR	1

AMONG MALIGNANT LESIONS	
MALIGNANT ROUND CELL TUMOR	6
SOFT TISSUE SARCOMA	3
SYNOVIAL SARCOMA	4
EWINGS SARCOMA	3
METASTATIC ADENOCARCINOMA	3
METASTATIC LYMPHNODES	2
FIBROUS HISTIOCYTOMA	1

B-Mode ultrasonography in differentiating benign from malignant musculoskeletal soft tissue masses

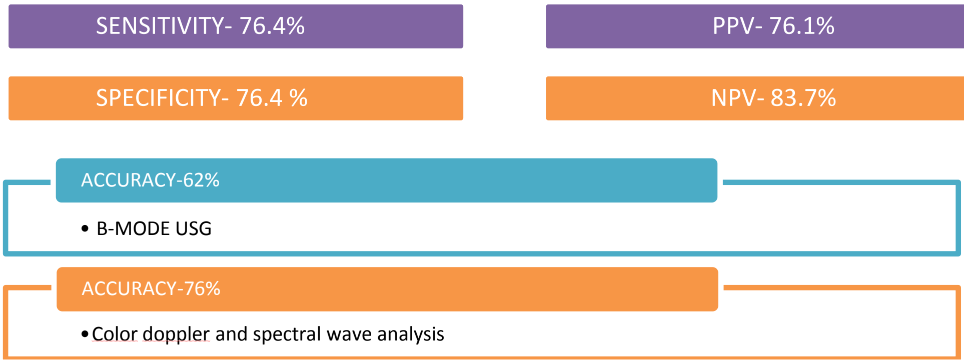
SENSITIVITY- 47.5%

PPV- 78.2%

SPECIFICITY- 80.3 %

NPV- 62.8%

Colordoppler and spectral wave analysis in differentiating benign from malignant musculoskeletal soft tissue masses



V. DISCUSSION:

Features that showed **significant** or highly significant correlation with **malignant nature** of the lesion include [5,7]

- ✓ Irregular Margins,
- ✓ Infiltrating Kind Of Growth Pattern And
- ✓ Heterogenous Internal Texture
- ✓ Infiltrating Or Mixed Tumor Growth,
- ✓ On Color Doppler examination, the extent and configuration of tumor vascularity were assessed on the basis of the following features:
- ✓ Presence Or Absence Of Flow Signals,
- ✓ Vessel Arrangement Within The Lesion (Regularly Distributed Or Randomly Dispersed),
- ✓ Vessel Course (Linear Or Tortuous), And
- ✓ Presence Or Absence Of Abrupt Variations In Calibre (Greater Than 50%).
- ✓ Malignancy Was Suspected On The Basis Of The Following Criteria:
- ✓ Randomly Dispersed Arrangement Of Tumor Vessels,
- ✓ Tortuous Vessel Course, Or
- ✓ Presence Of Abrupt Variations In Calibre.
- ✓ On pulsed Doppler evaluation, the following parameters were measured:
- ✓ Peak Systolic And End Diastolic Velocities,
- ✓ Resistive Index (RI).
- ✓ A threshold value of 0.50 for RI was arbitrarily assumed as a criterion for discriminating benign from malignant lesions (0.50 =<malignant ; 0.50 => malignant.)
- ✓

Features that showed **significant** or highly significant correlation with **benign** nature of the lesion include [6]

- ✓ Regular Margins,
- ✓ Expansive Kind Of Growth Pattern And
- ✓ Homogenous Internal Texture.

All Color Doppler and spectral wave analysis data showed highly significant (p-value < 0.001) correlation with their respective kind of nature of the lesion (benign/malignant)[8]

A **regularly** distributed arrangement of vessels with linear course and lesser than 50% abrupt variation in calibre of vessels showed highly significant correlation with **benign nature** of the lesion[9]

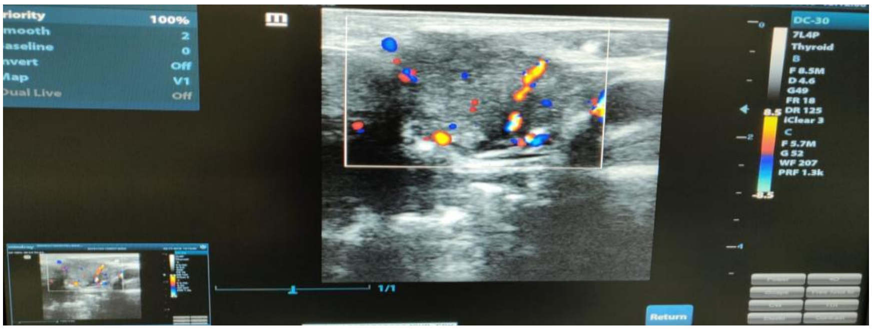
In contrast, **randomly** dispersed arrangement of vessels with **tortuosity** and greater than 50% abrupt variations in calibre of vessels showed highly significant(p-value <0.001) correlation with **malignant** nature of the lesion[10]

With regards to spectral wave analysis, **resistiveindex** was quite useful in the differential diagnosis between benign and malignant lesions[11]

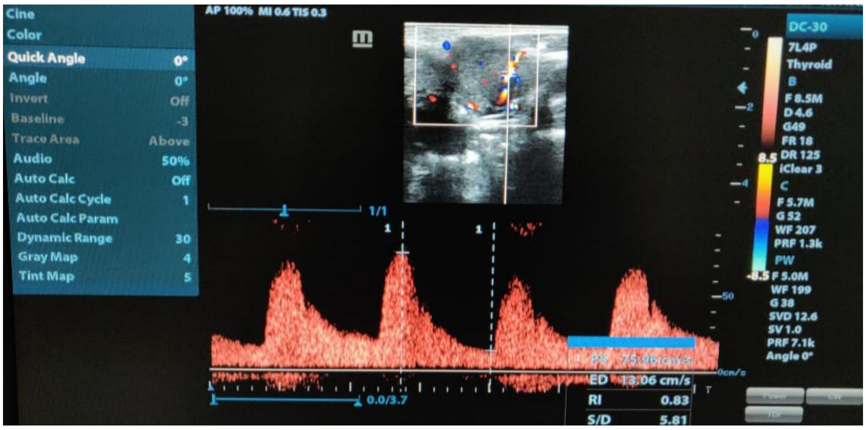
In our series, this was a reliable parameter for discriminating benign and malignant lesions.

A **threshold of 0.50** was best suited for distinction of benign from malignant tumors[12]

Thus, diagnostic accuracy was **improved** by combining sonographic findings with color and pulsed Doppler data.

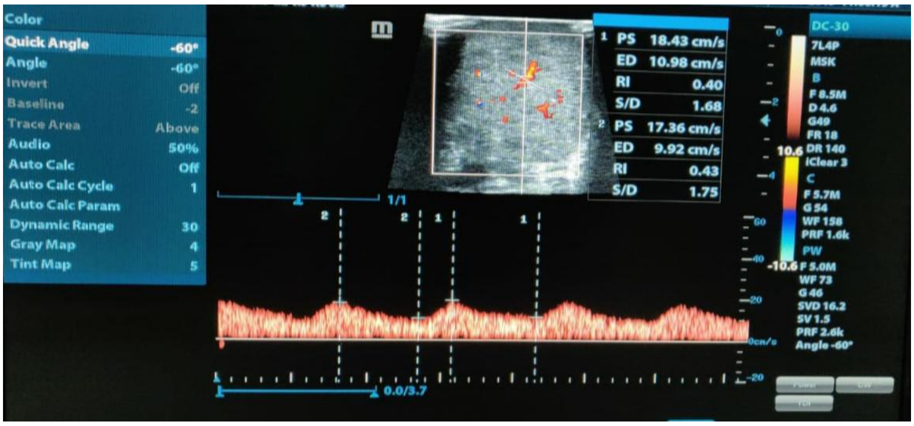


BENIGN FIBROHISTIOCYTIC LESION



HIGH RESISTANCE WAVEFORM IN THE ABOVE LESION

METASTATIC LYMPH NODE



LOW RESISTANCE WAVEFORM IN THE ABOVE LESION

VI. CONCLUSION:

- By our study we concluded that we can use B-mode, color Doppler ultrasonography and spectral wave analysis for assessing musculoskeletal soft tissue masses with good accuracy, sensitivity, specificity, positive predictive value and negative predictive value
- We can reliably differentiate benign from malignant soft tissue masses by using morphological as well as color Doppler features.
- Low Resistive indices (= or less than 0.5) of the internal vessels within the tumors also showed significant correlation with the malignant nature of the lesion. Thus spectral wave analysis can reliably differentiate benign from malignant soft tissue masses on the basis of resistive indices
- Our conclusions are based on a limited number of patients and should be validated on a larger series. In addition, the study population represented only some of the many different types of soft tissue tumors that can be encountered
- Color and spectral Doppler assessment might represent a useful adjunct to B-mode sonography and should be routinely performed when evaluating musculoskeletal soft tissue masses by ultrasonography

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